EXHIBIT A

[redacted]

[redacted]

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

TQ DELTA, LLC,

Plaintiff,

v.

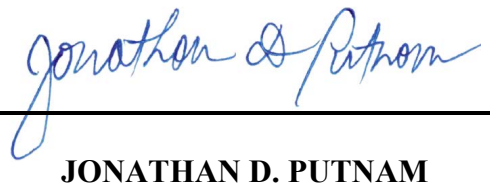
COMMSCOPE HOLDING COMPANY, INC., COMMSCOPE INC., ARRIS INTERNATIONAL LIMITED, ARRIS GLOBAL LTD., ARRIS US HOLDINGS, INC., ARRIS SOLUTIONS, INC., ARRIS TECHNOLOGY, INC., and ARRIS ENTERPRISES, LLC,

Defendants.

C. A. No. 2:21-cv-310

[redacted]

Corrected Expert Report of Jonathan D. Putnam



September 3, 2022

JONATHAN D. PUTNAM **September 3, 2022**

[redacted]

365. The identical chain of economic reasoning applies when these two claims appear in two different members of the same patent family: the values of the two members are not independent, but are perfectly negatively correlated.

366. Other scenarios may involve different types of interdependence among family members. For example, in the standard-essential patent context, patentees sometimes follow evolving language in the standard by filing new daughter applications that track the new language. Thus, it may be that only the latest member of the family is actually deemed essential to the standard. Again, under such circumstances, only the latest member has value.[461]

367. Approaches that assign value to individual family members generally ignore all of these interdependencies, by treating each family member independently of other members, when it is not independent. In general, all of these interdependencies can (and should) be avoided, by treating the family, not the individual patent, as the unit of observation.

(2) Data generation

368. The value of DSL technology as a whole must be divided among the inventions that contributed to it. I extract from a database of U.S. patent families those

[461] This particular circumstance also complicates the use of patent citations as an indicator of value—a commonly recognized relationship. Generally if not invariably, the most frequently cited member of the family is the first member (or the patent issuing from the first disclosure); subsequent members, which share most or all of the same specification, may not disclose new information and so do not merit additional grounds for citation by an examiner. Thus, while the first member may be most highly cited, it is the last member that may offer all the value – value that is underestimated by the relatively infrequent number of citations it receives.

[redacted]

patent families that are potentially essential to DSL standards.[462] In total, I calculate that there are approximately 11,166 potentially-essential DSL patent families owned by patentees that have made a declaration at the ITU.

369. To locate potentially-essential DSL patents, I begin by identifying patents that are subject to a "blanket declaration" at the ITU.[463] Based on DSL-related keywords, I identified all U.S. issued patents containing a reference to DSL-related technology.[464] Among those patents, I identified the subset owned by patentees having made a licensing commitment at the ITU.[465]

370. [redacted] Finally, I removed patents expired before 1999, when DSL technology

[462] Under ETSI's IPR Policy, the disclosure of one member of a family as potentially essential implies the disclosure of all members. As is standard, I include patent families having at least one U.S. member.

[463] "Blanket declaration" typically refers to a general statement, submitted by a company to a standard-setting body, indicating that the patentee owns intellectual properties it believes to be essential to a particular standard or set of standards, without reference to specific patent numbers.

[464] Derwent Innovation, October 18, 2017. [redacted]

[465] Intellectual property rights (IPR) in ITU Recommendations. ITU. Available at http://www.itu.int/net4/ipr/search.aspx?sector=ITU-T&class=PS&country=-1&org=-1&ps_country=-1&opt=-1&field=anokwcvd. Last accessed August 29, 2022.

[466] Included DSL recommendations are: ADSL2 (G.992.3), ADSL2+ (G.992.5), VDSL2 (G.993.2), G.vector (G.993.5), G.bond ATM (G.998.1), G.bond Ethernet (G.998.2), G.bond3(G.998.3), G.inp (G.998.4), G.hs (g.994.1), G.fast (G.9701).

[redacted]

became available in the U.S.[467] This left around 14,848 potentially-essential U.S. patents, within 11,166 patent families.[468]

(3) Patent sampling and technical analysis

371. To obtain a sample of the most relevant patents, [redacted]). I grouped all patents whose independent claims contained at least one knockout word together; these patents should be sampled at a lower rate, as they are unlikely to be essential. If the claims did not contain a knockout word, then I grouped the patents separately.

372. To segment each group of patents, I further grouped them into nine sub-categories, based on each patent's Derwent World Patents Index ("DWPI") Classification.[469] These second-level groupings were based on Dr. Cooklev's recommendation of DWPI Classifications more or less likely to contain a DSL-essential patent.[470]

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[467] See Section VI.D.

[468] To check whether this search is comprehensive, I compared the families of the asserted essential TQ Delta patents listed in Exhibit 6 (the only essential DSL patents which have been independently identified by number) with the families of the list of 14,848 potentially-essential DSL patents. All patent families appear in the "potentially-essential" list.

[469] Derwent is a reputable source for patent information. It's proprietary DWPI classification system accounts for variation arising from different names used for the same invention, translation of applications into other languages and keywords being used in multiple contexts. Therefore, "a subject classification system is essential for effective patent searching." "Derwent World Patents Index® (DWPITM)," Clarivate Analytics, available at https://clarivate.com/derwent/wp-content/uploads/sites/3/dlm_uploads/2019/08/DWPI-Classification-Guide-2020.pdf.

[470] See Cooklev Report, § XII.D. For a list of DWPI Classifications and descriptions, see "Derwent World Patents Index® Classification Guide," Clarivate, available at

[redacted]

373. In short, this segmentation procedure created a list of 2 x 9 = 18 subgroups. For sampling purposes, [redacted] Figure 5 illustrates the sample groupings. I then drew from each bucket a random (that is, representative) sample, large enough in size to ensure statistically reliable results.[471] To improve sampling efficiency, I over-sampled from the bucket identified by Dr. Cooklev as most likely to contain an essential patent. [472]

374. [redacted], implying an overall sample rate of 7.4%. Dr. Cooklev analyzed this sample and determined whether each patent in it is essential to one or more DSL standards.

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https://clarivate.com/derwent/wp-content/uploads/sites/3/dlm_uploads/2019/08/DWPI-Classification-2022.pdf ; "Derwent World Patents Index® (DWPITM)," Clarivate Analytics, available at https://clarivate.com/derwent/wp-content/uploads/sites/3/dlm_uploads/2019/08/DWPI-Classification-Guide-2020.pdf.

I understand from Dr. Cooklev that the DWPI Classification most likely to contain essential DSL patents is W01, followed by (not in rank order) S01, S02, T01, T02, U21, U22, U23, W02 and W03. According to Dr. Cooklev, Chemical, General and Mechanical Engineering Classifications (A-Q) are least likely to include essential DSL patents; the Electrical Engineering Classifications not specifically named by Dr. Cooklev (S-X, excluding those listed above) are also unlikely to contain essential DSL patents, but with a slightly higher likelihood than the Chemical, General and Mechanical Engineering Classifications.

[471] See Exhibit 11, Schedule C. Results are significant at the 95% confidence level. Bartlett, Kotrlik and Higgins, "Organizational Research: Determining Appropriate Sample Size in Survey Research," *Information Technology, Learning, and Performance Journal 19*(1) (Spring 2001).

[472] [redacted]

[redacted]

(4) Extrapolation from sample results

375. I incorporated Dr. Cooklev's essentiality determination for each of the sampled patents, relative to each DSL standard (ADSL, VDSL, G.vector, G.bond, G.inp and G.hs), as shown in Exhibit 11. I then extrapolated these determinations from the sample to the population to compute the expected number of actually-essential DSL families, with respect to each DSL standard.[473] [redacted]

[redacted]

or about 0.6% of all potentially-essential DSL families. Mapping patent families onto standards, I calculate that these 71 families are expected to be actually essential to one of the DSL standards in a total of 205 instances.

(5) The role of patent quality

376. In general, the value of patents varies from patent to patent, potentially for several reasons. Given the facts and data of the present case, I capture that variation by assigning greater royalties to TQ Delta patent families that are essential to more DSL standards. This procedure is consistent with

(a) *Georgia-Pacific* factor 11, which considers the actual usage of the invention – in this case, the greater usage associated with compliance with more standards;

(b) the inference that a patent that is essential to multiple standards has or may have broader claims;

[473] I perform this extrapolation using weights equal to the inverse of the patent or family sampling rate within each "bucket."

Exhibit 11, Schedule A
Sample size determination

		Population (N) patent groups [1]	[2]	[3]	Total
	Population (N)				
[a]	$N_{patents}$	1,118	4,043	9,687	14,848
[b]	$N_{families}$	807	2,982	7,377	11,166
	Sample (n)				
[c]	$n_{patents - required}$	286	351	369	1,006
[d]	$n_{patents - adjusted}$	380	351	369	1,100
	$n_{families - adjusted}$	277	264	285	826
[e]	Sample rate	0.34	0.09	0.04	
[f]	Sample weight	2.94	11.52	26.22	

Notes and sources :

[a] Schedule B

[b] Schedule B

[c] Required sample size given a 95.0% confidence level requirement, 0.5 variance parameter (most conservative choice) and a 5.0% acceptable error margin (see Schedule C). I apply Cochran's correction formula to adjust the final sample size in proportion to the relevant population group. See Bartlett, Kotrlik and Higgins, *Organizational Research: Determining Appropriate Sample Size in Survey Research* , Information Technology, Learning, and Performance Journal, Vol. 19, No. 1, Spring 2001, p. 47.

[d] I over-sample from Group 1 to achieve a sample-size of 1,100.

[e] = [d] / [a]

[f] = 1 / [e]

[redacted]

"Knockout" keywords [a]	DWPI classifications [b]	Number of patents [c]	Number of families [d]	Sampling group [e]
No	[1]	1,118	807	1
No	[2]	2,795	2,055	2
No	[3]	1,248	928	2
No	[4]	85	63	3
No	[5]	441	328	3
No	[6]	432	342	3
No	[7]	106	73	3
No	[8]	228	165	3
No	[9]	18	13	3
Yes	[1]	1,270	1,003	3
Yes	[2]	3,880	2,973	3
Yes	[3]	998	734	3
Yes	[4]	156	124	3
Yes	[5]	583	426	3
Yes	[6]	546	441	3
Yes	[7]	264	205	3
Yes	[8]	652	466	3
Yes	[9]	28	21	3
		14,848	11,166	

Notes and sources :

[a] See Schedule D. According to Dr. Cooklev, these "knockout" words are unlikely to be found in the claims of an essential DSL patent. I classify a patent as "'knockout' keywords" = "Yes" if every independent claim of the patent contains at least one instance of a keyword identified by Dr. Cooklev.

[b] Disjoint classification of patents within groups according to their Derwent World Patents Index ("DWPI") Classification. Patents are often placed by Derwent in more than one Classification. For a list of DWPI Classifications and descriptions, see "Derwent World Patents Index® Classification Guide," Thomson Reuters, August 2012, available at http://ips.clarivate.com/m/pdfs/DWPIClassificationManual2012.pdf; "Derwent World Patents Index® (DWPITM)," Clarivate Analytics, December 2016, available at http://ips.clarivate.com//m/pdfs/mc-revision-2017/DWPI_Classification_Manual_2017_website.pdf.
I understand from Dr. Cooklev that the DWPI Classification most likely to contain essential DSL patents is W01, followed by (not in rank order) S01, S02, T01, T02, U21, U22, U23, W02 and W03. According to Dr. Cooklev, Chemical, General and Mechanical Engineering Classifications (A-Q) are least likely to include essential DSL patents; the Electrical Engineering Classifications not specifically named by Dr. Cooklev (S-X, excluding those listed above) are also unlikely to contain essential DSL patents, but with a slightly higher likelihood than the Chemical, General and Mechanical Engineering Classifications. See Cooklev Report, Section XII.D.

[b1] W01 only.

[b2] W01 and any of (S01, S02, T01, T02, U21, U22, U23, W02 or W03), excluding other Classifications S-X and Classifications A-Q.

[b3] (S01, S02, T01, T02, U21, U22, U23, W02 or W03) only.

[b4] W01 and at least one other Classification S-X, excluding S01, S02, T01, T02, U21, U22, U23, W02 and W03 and Classifications A-Q.

[b5] W01 and any of (S01, S02, T01, T02, U21, U22, U23, W02 or W03) as well as at least one other Classification S-X, excluding Classifications A-Q.

[b6] (S01, S02, T01, T02, U21, U22, U23, W02 or W03) and at least one other Classification S-X, excluding W01 and Classifications A-Q.

[b7] Any Classification S-X, excluding W01, S01, S02, T01, T02, U21, U22, U23, W02 and W03, and not including Classifications A-Q.

[b8] Any Classification S-X if it also has a Classification A-Q; also includes patents with no DWPI Classification.

[b9] Patents with Classifications A-Q only.

[c] I generate a list of relevant DSL patents by first identifying all U.S. patents containing the acronym "[x]DSL" (allowing for variations of DSL: ADSL, VDSL, etc.) or the words "digital subscriber line" in the patent's title, claims, abstract or description (Derwent Innovation, October 18, 2017). To further restrict that list to patents potentially essential to ITU (International Telecommunication Union) DSL standards, I remove patents from the "DSL keyword" list that are not owned by patentees having made general declaration statements to the ITU. I also include any patents disclosed specifically to ITU DSL standards that did not result from the "DSL keyword" search. See "Intellectual property rights (IPR) in ITU Recommendations," International Telecommunication Union. Available at http://www.itu.int/net4/ipr/search.aspx?sector=ITU-T&class=PS&country=-1&org=-1&ps_country=-1&opt=-1&field=anokwcvd.
To limit the list of potentially essential patents that were active at the time DSL standards were first adopted, I exclude any patents expired or lapsed prior to 1999 (see, for example, ADSL – Introduction; “DSL Technology Evolution,” Broadband Forum. Available at https://www.broadband-forum.org/downloads/About_DSL.pdf).

[d] Patents are grouped into families according to their INPADOC Identification Codes (Derwent Innovation, October 18, 2017). For families with patents falling into multiple groups, I divide the family evenly among the relevant groups, depending on the number of constituent patents within each group.

[e] I divide patents into groups from which to sample, based on their general likelihood to include DSL-relevant patents.

Exhibit 11, Schedule C
Sampling assumptions

Confidence level (C)	95.0%
p_C	0.025
Z_p	1.96
Margin of error	5.0%
Variance parameter	0.50

Notes and sources:

Bartlett, Kotrlik and Higgins, *Organizational Research: Determining Appropriate Sample Size in Survey Research*, Information Technology, Learning, and Performance Journal, Vol. 19, No. 1, Spring 2001.

[redacted]

acceleration
accelerators
accessories
address
addressed
addresses
addressing
advertising
aerials
AFC
air
aircraft
airport
AND-gates
antenna
antennas
antiphase
arc
arming
astable
attendance
audio
audio/video
audio-communication
automotive
AV
aviation
baluns
base station
base stations
batteries
battery
BICMOS
bipolar
bistable
blood
boards
brakes
braking
breakers
broadcast
broadcasting
broadcasts
burglar
call
calorimetry
camera
cameras
car
cars
CCD
cell
cell phone
cell signal
cell signaling
cell tower
cells
cellular
cellular base station
cellular phone
cellular signal
cellular tower
ceramic
chargers
charging
chemical
cleaners
cleaning
CMOS
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coils
coin
collision
collisions
colour
compression
conductive
constructional
cookers
cooling
cordless
CRTs
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currency
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fuses
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gas
geophysics
geothermal
heaters
heating
HEMT
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hygiene
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ink
insulating
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irons
ISDN
jamming
karaoke
key
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keys
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laser
lasers
LED
LEDs
LF
lidar
lifting
lifts
light
lighting
limiters
liquid
local area network
locking
loudspeaker
MAC
machine
machines
magnetic
magnetically
magneto-optical
magnetrons
magnets
manufacture
marine
maser
masers
materials
mechanical
medical
medium access layer
metals
meteorology
metering
MHD
microwave
military
missile
mobile
mobile device
mobile phone
mobile signal
mobility
motors
mountings
movers
multicast
multicasting
multimedia
multipoint
multipoints
musical
node
nodes
non-electrical
non-electrochemical
non-electrolytic
non-engine
non-fossil
nuclear
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optoelectronic
ore
ovens
packages
paging
panels
paper
particle
passive
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PDM
PFM
photodetectors
photoelectric
photography
photometry
photovoltaic
plain old telephone service
plants
plasma
point-of-sale
polarisers
portable
POS
POTS
PPM
press
printed
printers
projection
projectors
propulsion
pumping
pumps
punches
quantum
racks
radar
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reactors
readers
rectifiers
refrigerators
relay
relays
reproducing
reproduction
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routinely
routing
safety
satellite
satellites
screening
secret
sensors
server
servers
session
sessions
sewing
shapers
ship
sighting
simulators
smart
solar
soldering
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solvers
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spark
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stereoscopic
still-picture
studio
substrate
superconducting
superconductive
suspensions
switch
switchboards
switched
switches
switchgear
switching
switchyards
tape
telecontrol
telemetry
telephone call
telephone calls
teletext
thermally
thermistors
thermoelectric
thermometers
thick
thin
thyristors
ticket
tomography
traction
transducers
transponders
trolley
tubes
TV
T-W
TWTs
ultrasonic
unipolar
vacuum
valves
VDRs
VDUs
vehicle
vehicles
velocity
vending
veterinary
vibrating
vibrations
virtual private network
voice
voiced
voices
voicing
voltage
volume
VPN
wafer
washing
watches
water
waveguides
weapons
welding
wind
work
xerography
X-radiation
X-ray

Notes and sources :

Cooklev Report, Section XII.D.

Exhibit 11, Schedule E
DSL patent classifications - update

DWPI classifications [a]	Number of patents [b]	Number of families [c]	Sampling group [d]
[1]	8	6	1
[2]	36	33	2
[3]	10	10	2
[4]	3	3	3
[5]	2	2	3
[6]	13	11	3
[7]	1	1	3
[8]	2	2	3
[9]	-	-	3
Total	75	67	

Notes and sources :

See Schedule D. I conservatively do not perform a "knockout" word analysis on the patents found potentially essential to DSL as there were so few new patents.

[a] Disjoint classification of patents within groups according to their Derwent World Patents Index ("DWPI") Classification. Patents are often placed by Derwent in more than one Classification. For a list of DWPI Classifications and descriptions, see "Derwent World Patents Index® DWPI Classification: Edition 10," Clarivate Analytics, 2020, available at https://clarivate.com/derwent/wp-content/uploads/sites/3/dlm_uploads/2019/08/DWPI-Classification-Guide-2020.pdf.
I understand from Dr. Cooklev that the DWPI Classification most likely to contain essential DSL patents is W01, followed by (not in rank order) S01, S02, T01, T02, U21, U22, U23, W02 and W03. According to Dr. Cooklev, Chemical, General and Mechanical Engineering Classifications (A-Q) are least likely to include essential DSL patents; the Electrical Engineering Classifications not specifically named by Dr. Cooklev (S-X, excluding those listed above) are also unlikely to contain essential DSL patents, but with a slightly higher likelihood than the Chemical, General and Mechanical Engineering Classifications. See Cooklev Report, Section XII.D.

[a1] W01 only.
[a2] W01 and any of (S01, S02, T01, T02, U21, U22, U23, W02 or W03), excluding other Classifications S-X and Classifications A-Q.
[a3] (S01, S02, T01, T02, U21, U22, U23, W02 or W03) only.
[a4] W01 and at least one other Classification S-X, excluding S01, S02, T01, T02, U21, U22, U23, W02 and W03 and Classifications A-Q.
[a5] W01 and any of (S01, S02, T01, T02, U21, U22, U23, W02 or W03) as well as at least one other Classification S-X, excluding Classifications A-Q.
[a6] (S01, S02, T01, T02, U21, U22, U23, W02 or W03) and at least one other Classification S-X, excluding W01 and Classifications A-Q.
[a7] Any Classification S-X, excluding W01, S01, S02, T01, T02, U21, U22, U23, W02 and W03, and not including Classifications A-Q.
[a8] Any Classification S-X if it also has a Classification A-Q; also includes patents with no DWPI Classification.
[a9] Patents with Classifications A-Q only.

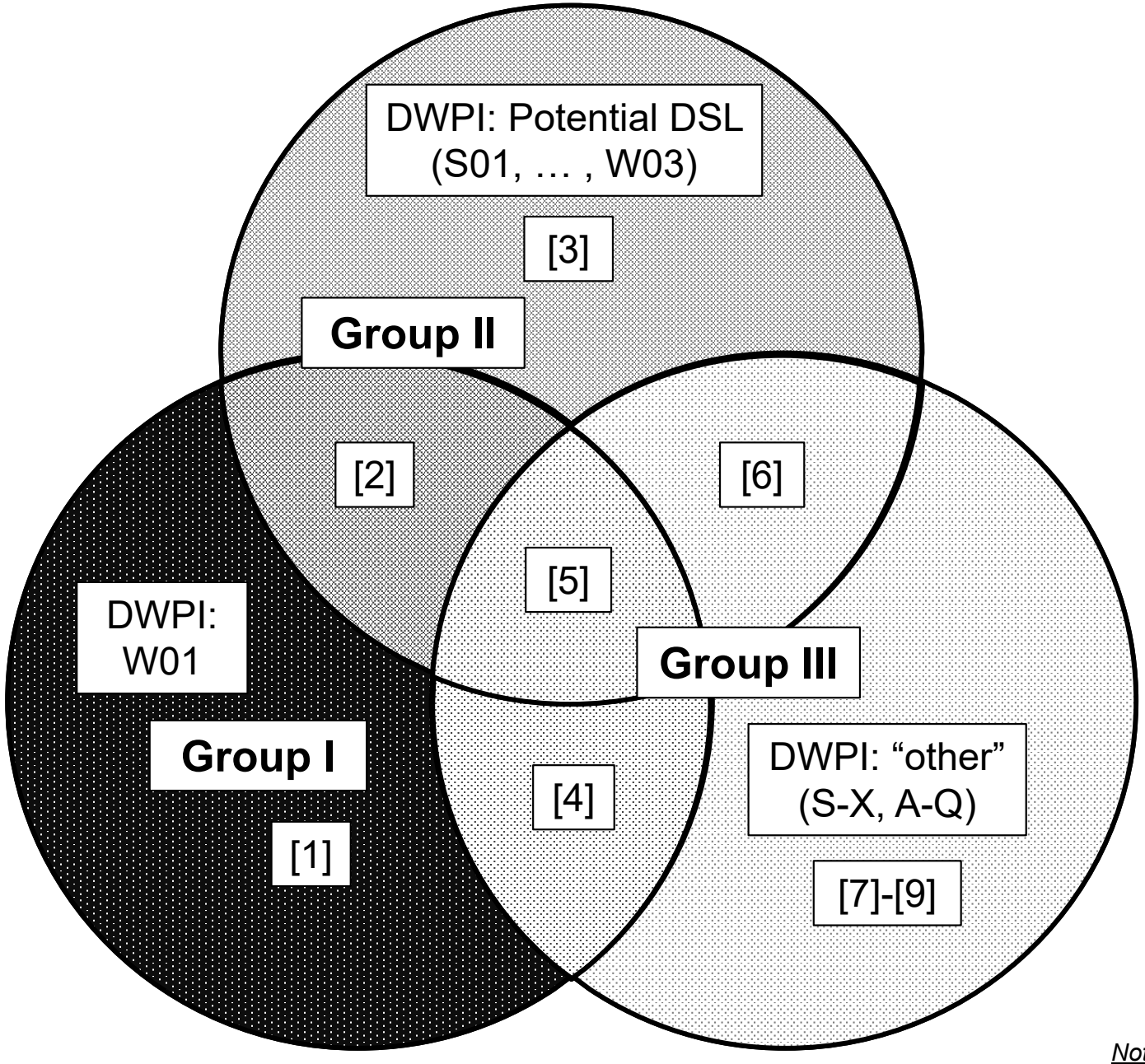
[b] To update DSL essentiality since I last ran this analysis in October 2017, I generate a list of relevant DSL patents by first identifying all U.S. patents granted after October 11, 2017 with an earliest priority date of before June 11, 2010, containing the acronym "[x]DSL" (allowing for variations of DSL: ADSL, VDSL, etc.) or the words "digital subscriber line" in the patent's title, claims, abstract or description (Derwent Innovation, August 18, 2021). To further restrict that list to patents potentially essential to ITU (International Telecommunication Union) DSL standards, I remove patents from the "DSL keyword" list that are not owned by patentees having made general declaration statements to the ITU. I also include any patents disclosed specifically to ITU DSL standards that did not result from the "DSL keyword" search. See "Intellectual property rights (IPR) in ITU Recommendations," International Telecommunication Union. Available at http://www.itu.int/net4/ipr/search.aspx?sector=ITU-T&class=PS&country=-1&org=-1&ps_country=-1&opt=-1&field=anokwcvd. I then compared unique families to those I had already considered in prior running of this analysis and removed any duplicates so only truly new families were considered.

[c] Patents are grouped into families according to their INPADOC Identification Codes (Derwent Innovation, October 18, 2017). For families with patents falling into multiple groups, I divide the family evenly among the relevant groups, depending on the number of constituent patents within each group.

[d] I divide patents into groups from which to sample, based on their general likelihood to include DSL-relevant patents.

[redacted]

DSL Patent Sampling



Notes and Sources:
See Exhibit 11, Schedule B